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Effect of Temperature and Moisture on the Shelf Life of Fresh Produce

By

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PRELIMINARY

Report of a study made under the
Research and Marketing Act of 1946
Project No. 52

Division of Fruit and Vegetable Crops and Diseases

July 28, 1949
Beltsville, Maryland

Effect of Temperature and Moisture on the Shelf Life of Fresh Produce 1/

Introduction

The purpose of this work was to determine the shelf life of certain items of produce under different conditions of temperature and moisture. The commodities tested were those in which there is a difference of opinion regarding the effect of moisture and temperature on keeping quality.

Uniform produce was held on: an ice bed rack, a dry rack with an ice garnish, a dry rack where moisture was added by sprinkling and with night storage at 40°F. and a relative humidity of about 88 percent, and a dry rack with no moisture added and no cool storage provided.

The commodities tested to date are: snap beans, lima beans, beets, cucumbers, eggplant, spring onions, peas, peppers, radishes, and yellow summer squash. Four separate tests were made with most of the commodities listed above. The quantity of produce displayed on the racks was similar to that displayed by merchants with a small to medium volume of business. Conclusions drawn from these preliminary studies, therefore, do not necessarily apply to large scale handling and displaying of fresh produce.

Equipment Used

Display Racks:

1. A 5-foot commercial (Bohn) sloping ice bed rack with a mirror back.
2. A section of a horizontal tray 8 feet long and 3 feet wide for the garnished display.
3. A section of a horizontal tray 8 feet long and 3 feet wide for the sprinkled display.
4. A horizontal table 5 feet long and 3 feet wide for the dry rack display.

Temperature and Humidity Equipment

The commodity temperature and certain other temperature readings in the display cases were made with fruit thermometers. Temperature and relative humidity readings were taken twice daily with a psychrometer in the display room. Continuous temperature and humidity records were recorded by hygrothermographs in the display room and in the night storage room.

1/ Report of a study made under the Research and Marketing Act of 1946, Project No. 52.

Methods and Procedures

All commodities were purchased at the local wholesale market. The best quality produce available on the market was purchased, however, most of it was of only good or fair quality. An attempt was made to unify or composite the produce so that it would be comparable on all display racks. Summer squash, cucumbers, and bell peppers were classified according to maturity, soundness, and mechanical injury. These catagories then were divided equally among the displays. Unification of commodities such as snap beans, lima beans, and peas included the removal of debris, decay and a thorough mixing of the entire test lot.

Following grading, the commodities for each display were washed and then weighed. All commodities were at room temperature when placed on the display racks.

All display racks were operated as uniformly as possible.

An ice bed rack was maintained with a 3 inch snow ice bed throughout the tests. Each day a garnish of snow ice was spread over the top of the produce to a depth of about 1 inch immediately after the display was rebuilt. At noon a 1/2 inch ice garnish was used while in the evening 1-1/2 to 2 inches were used. The rack was covered overnight with a heavy canvas.

The display rack, with no ice beneath the produce but with snow ice spread over the top as a garnish, is referred to in this report as a garnished display rack. A 1 inch garnish of ice was spread over the top of the produce each morning after the display was rebuilt and again at noon. In the evening a heavier garnish of about 2 inches of ice was used, and the rack was covered overnight with 2 thicknesses of heavy paper.

The dry rack display, sprinkled with water during the day and stored at 40°F. at night, is referred to in this report as a sprinkled display rack. During the day the produce was sprinkled with tap water at intervals of about 1-1/2 hours. In the evening this produce was placed in containers, covered with heavy paper, and stored overnight at 40°F. and approximately 88 percent relative humidity.

The dry rack received no sprinkling or night storage and was rearranged each day following weighing and trimming.

Each morning the temperatures were recorded before the racks were disturbed. The produce was then weighed and weight changes and spoilage recorded. Losses due to trimming, withering, aging, or decay were considered as spoilage. After removal of the spoilage the remaining produce was graded on a numerical basis from 1 to 9 as follows and returned to the display rack: 1 - excellent, 2 - excellent to good, 3 - good, 4 - good to fair, 5 - fair, 6 - fair to poor, 7 - poor, 8 - poor to unsalable, and 9 - completely unsalable.

RESULTS

Temperature and Humidity

Display Room

The room temperature, display rack temperature and relative humidity are shown in Table 1. The room temperature was usually about 78°F. and the relative humidity about 70 percent.

Ice Bed Rack

The commodity temperature on the ice bed rack varied between 38°F. and 51°F. but was usually around 45°F. The air temperature immediately above the commodities ranged from 60° to 66°F. whereas the air temperature beneath the commodities ranged from 33° to 37°F. Morning temperatures, taken at 8:15 when the produce was uncovered, were higher than afternoon temperatures taken 3 hours after the noon garnishing. The temperatures on the ice bed rack were low enough to hold spoilage to a minimum in most commodities for 4 days. There was sufficient moisture to maintain or to gain weight.

Garnished Rack

The commodity temperature on the garnished rack was usually about 58°F. The air temperature above the commodities was about 67°F. which was only slightly warmer than that of the ice bed rack. The air temperature beneath the commodity stayed around 57°F. which is only 6° cooler than the warmest position on the ice bed rack. Morning temperatures taken at 8:15 were higher than afternoon temperatures taken 3 hours after the commodities were garnished with ice. The temperatures on the garnished rack were low enough to check somewhat the development of spoilage but did not maintain condition as well as did the ice bed rack. Moisture conditions were such that most commodities either maintained or gained weight.

Sprinkled Rack

Only the commodity temperature was taken on the sprinkled rack. This temperature was about 44°F. when removed from storage in the morning but rose to around 73°F. in the afternoon. The low night temperature slowed the development of spoilage but not as much as that of the ice bed and garnished racks. Moisture conditions were such that most commodities gained or at least lost very little weight.

Dry Rack

All the temperatures taken on the dry rack were very close to the room temperature. Although the display was dry, there was excessive decay in many commodities along with severe withering and loss in weight.

Table 1. Temperature and Humidity Readings on Display Racks.

Position	Type Rack	Monday	Tuesday		Wednesday		Thursday		Friday	
		3:00PM	8:15AM	3:00PM	8:15AM	3:00PM	8:15AM	3:00PM	8:15AM	3:00PM
Air Temperature	Room	78°	73°	81°	78°	78°	78°	78°	77°	79°
Relative Humidity	Room	67%	70%	68%	74%	78%	77%	70%	71%	58%
Air Temp. Top Produce	Ice Bed	67°	60°	66°	64°	61°	67°	64°	62°	66°
Commodity Temp.	Ice Bed	51°	51°	43°	46°	33°	43°	45°	47°	47°
Air Temp. Beneath Produce	Ice Bed	33°	35°	34°	35°	35°	37°	33°	35°	33°
Air Temp. Top Produce	Garnished	53°	68°	65°	71°	65°	67°	61°	74°	71°
Commodity Temp.	Garnished	54°	67°	53°	63°	49°	61°	55°	64°	56°
Air Temp. Beneath Produce	Garnished	49°	69°	49°	63°	46°	62°	53°	66°	51°
Commodity Temp.	Sprinkled	77°	44°	69°	43°	73°	44°	75°	45°	74°
Air Temp. Top Produce	Dry	77°	73°	80°	78°	78°	79°	79°	78°	78°
Commodity Temp.	Dry	76°	77°	77°	79°	78°	79°	79°	78°	77°
Air Temp. Beneath Produce	Dry	76°	78°	77°	78°	73°	81°	75°	76°	78°

Commodity

Green Beans

Green pod type beans, locally grown, and Bountiful type, grown in New Jersey, were used in the tests. The beans were fresh and in good condition when purchased except for occasional *Anthracnose* lesions in one lot and bacterial blight lesions in another. The worst of the diseased pods were sorted out in preparing the beans for display. No additional losses resulted from these diseases during the 4 day display. Figures 1, 2, and 3 show the results of 4 days on the 4 types of display racks.

Ice Bed Rack. — The beans on the ice bed rack absorbed moisture resulting in an increase in weight of 2 percent. They improved in crispness and remained in good condition with no losses during the 4 day display period.

Garnished Rack. — The beans garnished with ice gained 4 percent in weight due to water absorption. They improved in crispness but did not maintain the condition found on the ice bed. Spoilage due to *Pythium* rot caused a loss of 0.25 percent by the third day, however, this loss was offset by the gain in weight.

Sprinkled Rack. — Beans sprinkled with water during the day and stored at 40°F. at night remained in good condition throughout the 4 day display period. The beans gained 3 percent in weight due to absorption of water, and there was no decay.

Dry Rack. -- Beans displayed on the dry rack without day care or night storage remained in good condition for only 1 day. They were in good to fair condition after 2 days and were poor to unsalable on the fourth day. Spoilage during the 4 day period amounted to 22 percent and weight loss was 16 percent making a total loss of 38 percent of the original weight.

All Racks. — Physiological russeting did not occur on any of the display racks.

Of the 4 types of display racks, the ice bed kept the beans fresher, greener and crisper.

Comparison of green beans on 4 types * of display racks during a 4 day period.

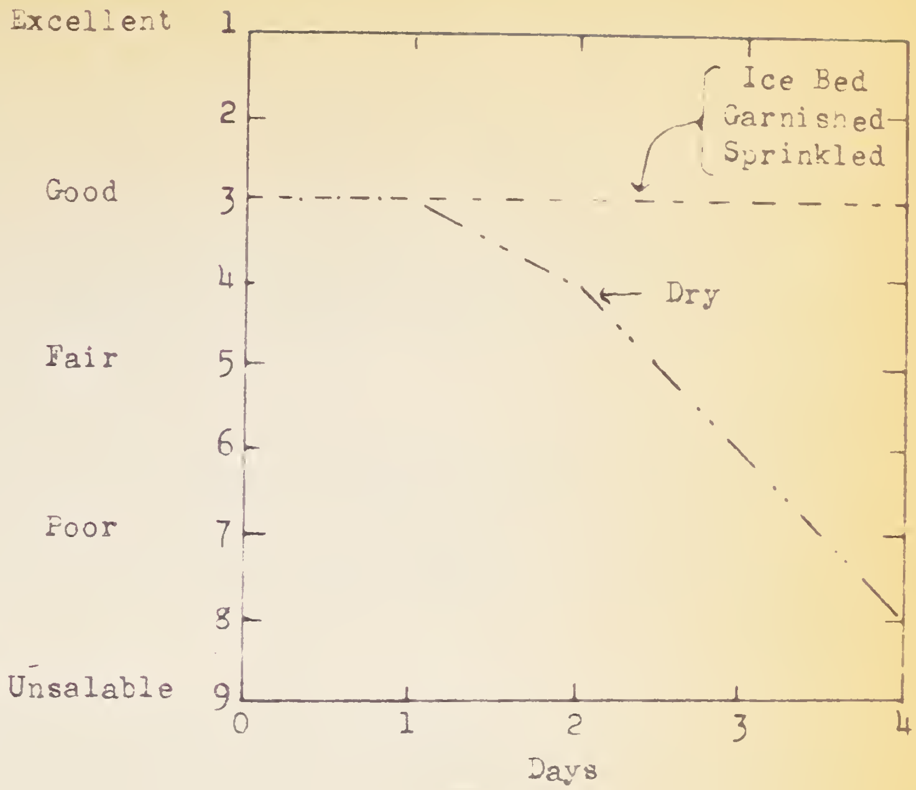

Figure 2. The daily condition of the pods.

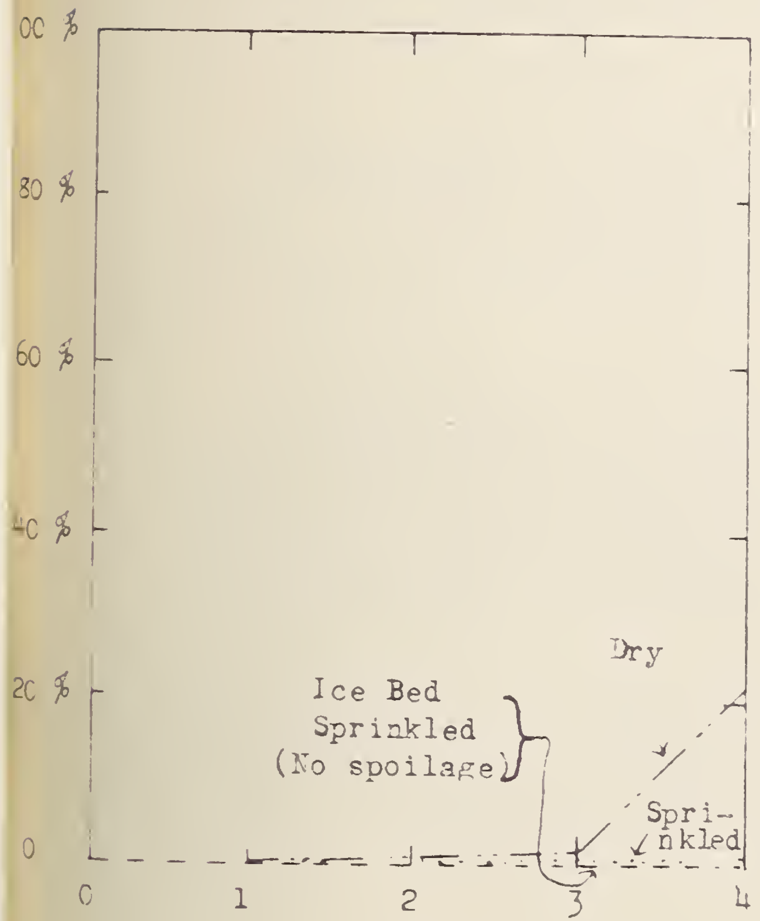

Figure 1. The daily percentage of accumulated spoilage.

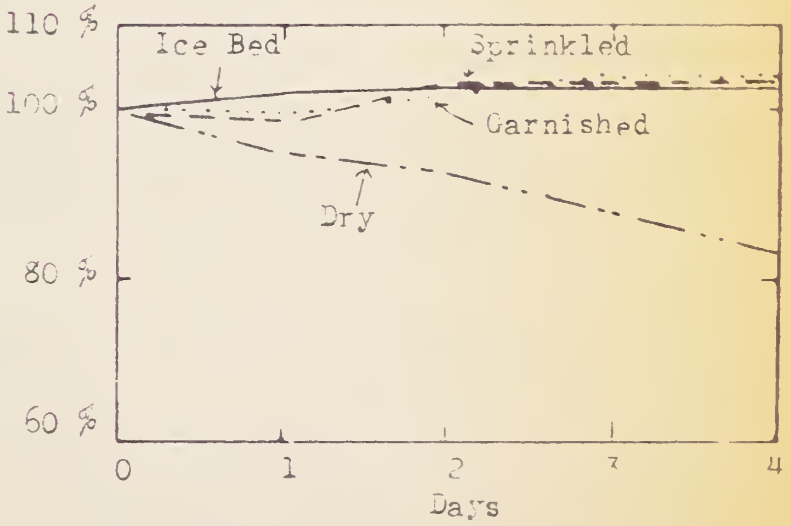

Figure 3. The daily percentage of accumulated loss or gain in weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Lima Beans

Lima beans grown locally and in New Jersey were used in these tests. The beans from New Jersey had many reddish brown specks on the pods but generally were in good condition. Figures 4, 5, and 6 show the results on the 4 types of display racks for 4 days.

Ice Bed Rack -- The beans on the ice bed rack gained almost 2 percent in weight due to the absorption of moisture. They improved in crispness and remained in good condition 3 days and were in good to fair condition the fourth day. The 1 percent spoilage was yellowing of the pods. There was no decay.

Garnished Rack -- Lima beans garnished with ice gained 5 percent in weight in 4 days. Spoilage due to Pythium decay and aging was 2 percent. This loss was more than offset by the 5 percent gain in weight. The beans were in good condition 2 days and fair condition the fourth day.

Sprinkled Rack -- The beans on the sprinkled rack remained in good condition 2 days and were in fair condition on the fourth day. Spoilage due to Pythium decay and aging caused a 5 percent loss by the third and fourth days. There was a 3 percent gain in weight which did not completely offset the spoilage loss but did reduce the total loss to only 2 percent of the original weight.

Dry Rack -- Lima beans displayed on the dry rack remained in good condition only 1 day. They were in poor condition on the fourth day. Spoilage due to Pythium decay, bacterial decay, and aging was 31 percent during the 4 day period. Weight loss amounted to 7 percent giving a total loss of 38 percent.

All Racks -- The reddish-brown speckling increased uniformly on the 4 different types of display racks.

The ice bed rack kept the beans fresher and crisper than did the other types of racks.

Comparison of Lima beans on 4 types * of display racks during a 4 day period.

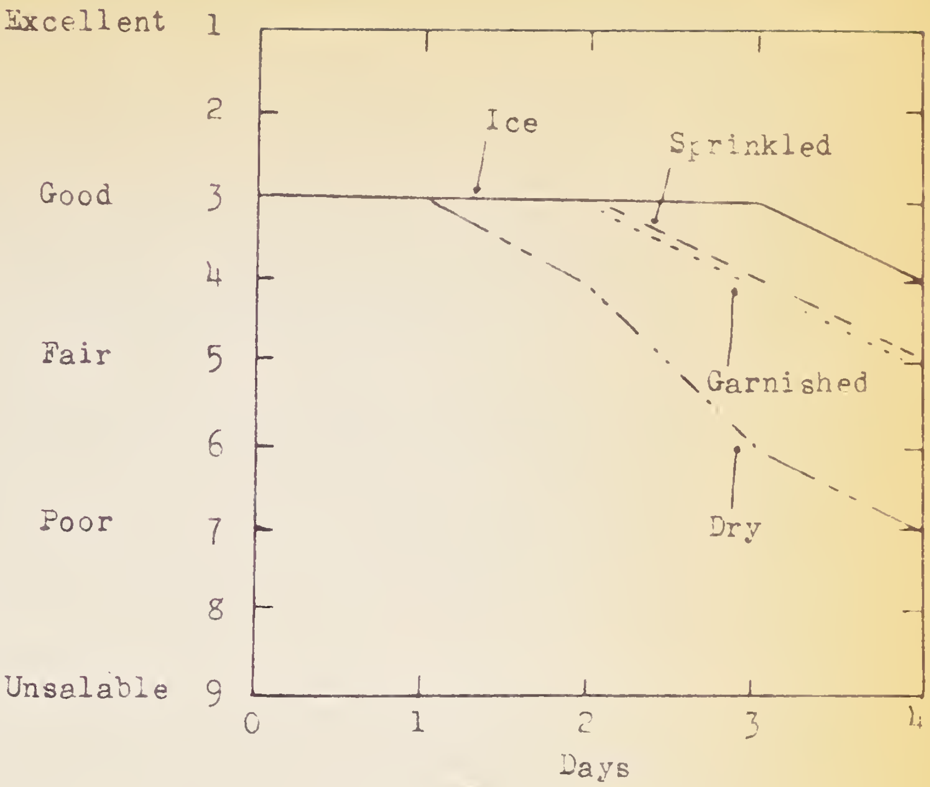

Figure 5. The daily condition of the pods

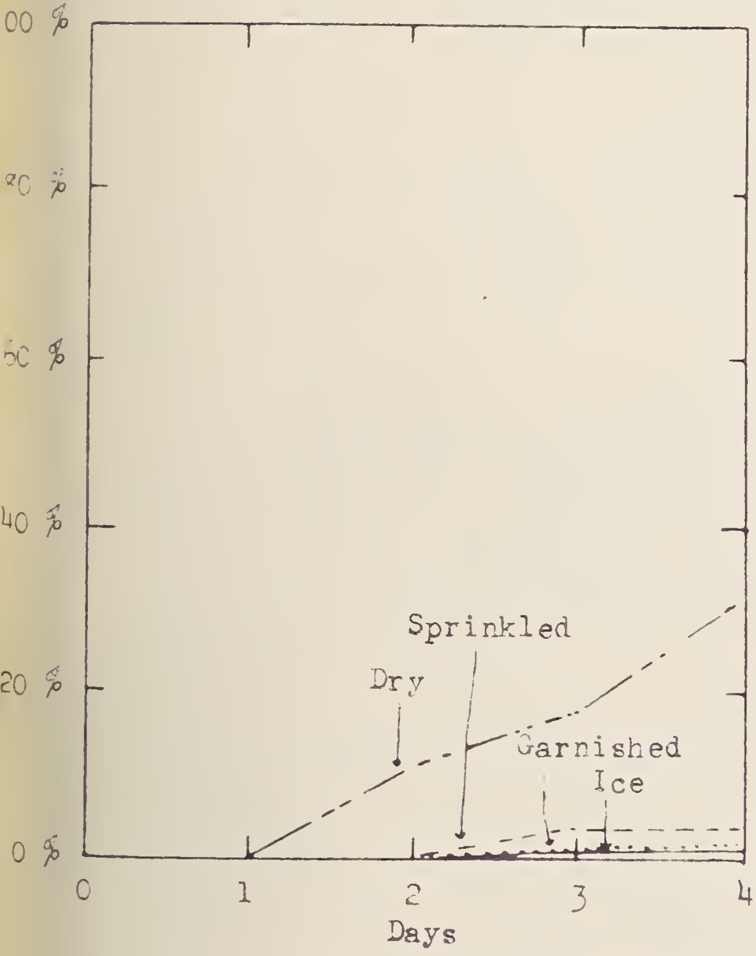

Figure 4. The daily percentage of accumulated spoilage.

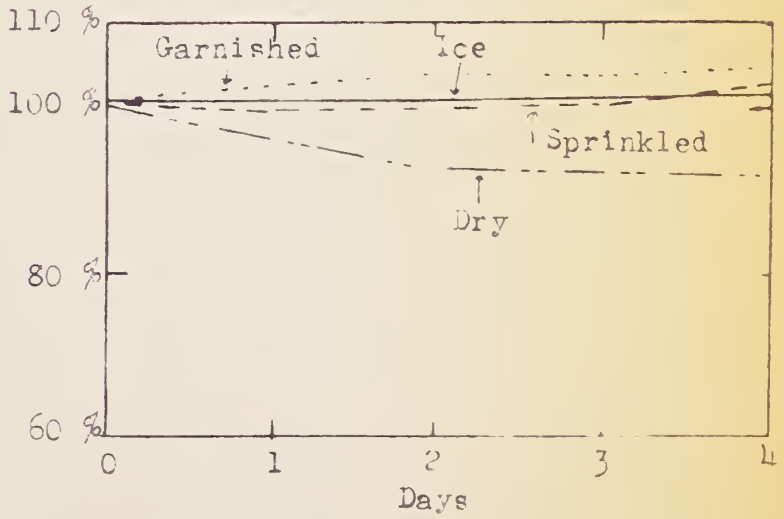

Figure 6. The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Beets

Beets grown on the Eastern Shore of Maryland and in New York were used in the tests. The roots were in good turgid condition, but the tops were bruised and slightly discolored. Figures 7, 8, and 9 show the results during 4 days on the 4 types of display racks

Ice Bed Rack. - The tops of the beets remained in good condition only 1 day on the ice bed, while the roots remained in good condition throughout the 4 day period. During this time there was a gain in weight of nearly 4 percent due to water absorption. There was some aging and bacterial decay in the tops after the first day but it was not as extensive as on the other types of racks.

Garnished Rack. — The beet tops garnished with ice were in a good to fair condition after 1 day. There was some bacterial decay in the tops on the fourth day, but the tops were in a fair condition. The roots remained turgid and no spoilage occurred during the 4 day period. The increase in weight was about 2 percent.

Sprinkled Rack. — The beets on the sprinkled rack were in good to fair condition the first day. On the second and third days the condition was fair to poor. Bacterial decay in the tops on the third day resulted in a 41 percent loss. On the fourth day the roots were turgid and sound, but the tops were decayed. The beets gained 3 percent in weight which would reduce the above loss to 38 percent of the original weight.

Dry Rack. -- Beets displayed on the dry rack broke down rapidly. Bacterial decay advanced in the tops reducing their condition from good to fair by the end of the first day. Their condition was poor at the end of 2 days. Although all were not discarded until the fourth day, the tops were almost completely decayed the third day. The roots had lost moisture and were shrivelling by the fourth day. The 8 percent loss in weight together with the 92 percent spoilage in the tops resulted in 100 percent loss.

Comparison of beets on 4 types * of display racks during a 4 day period.

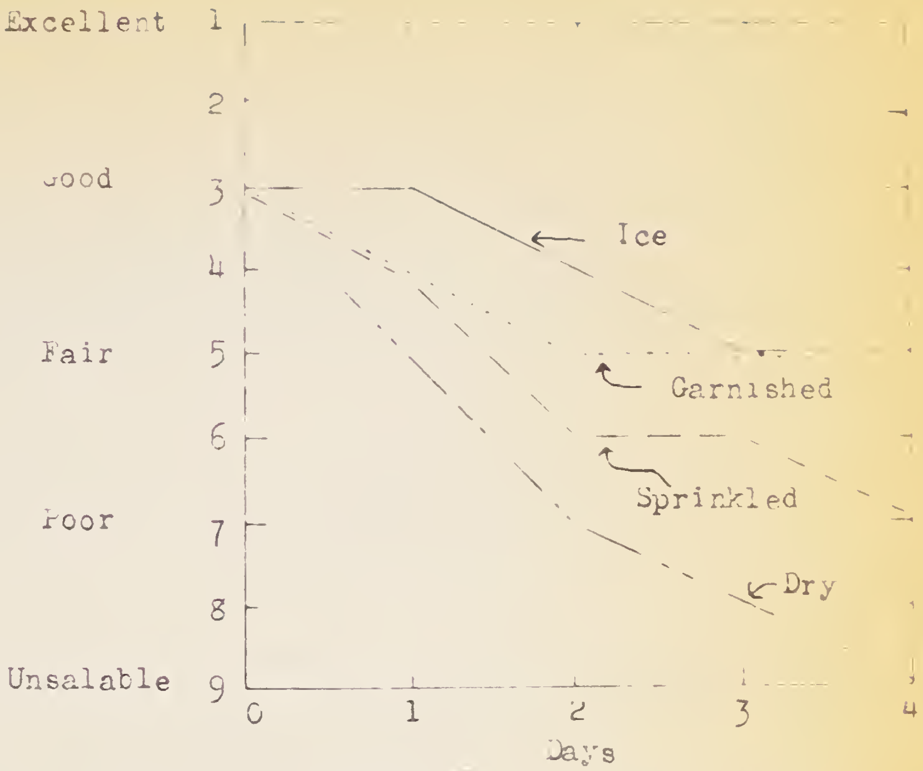

Figure 8. The daily condition of the beets.

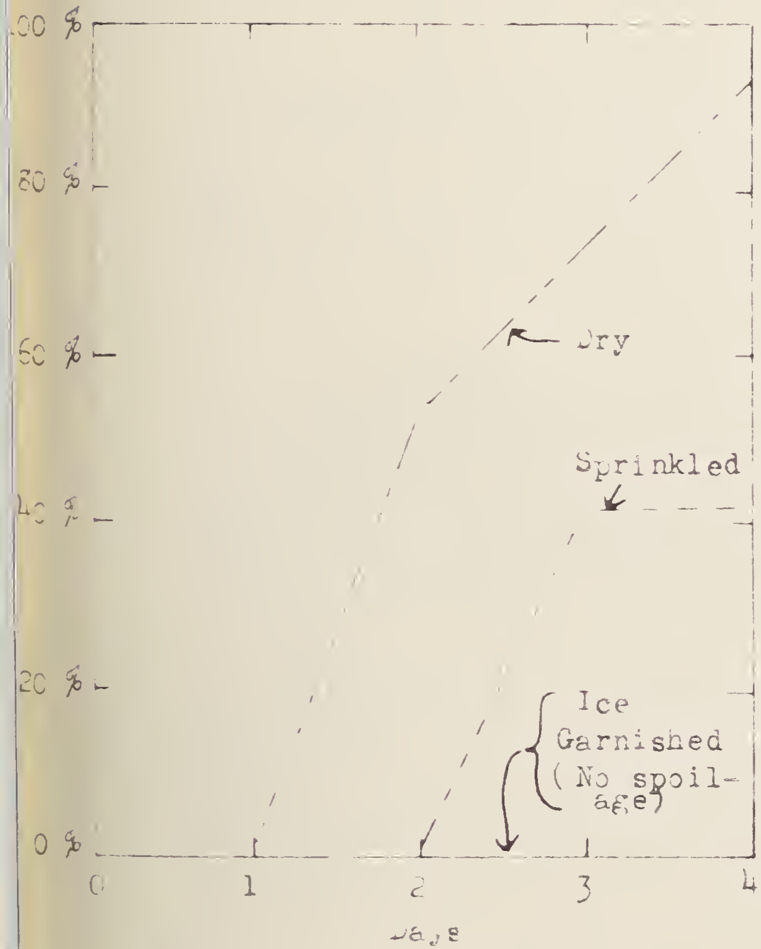

Figure 7. The daily percentage of accumulated spoilage.

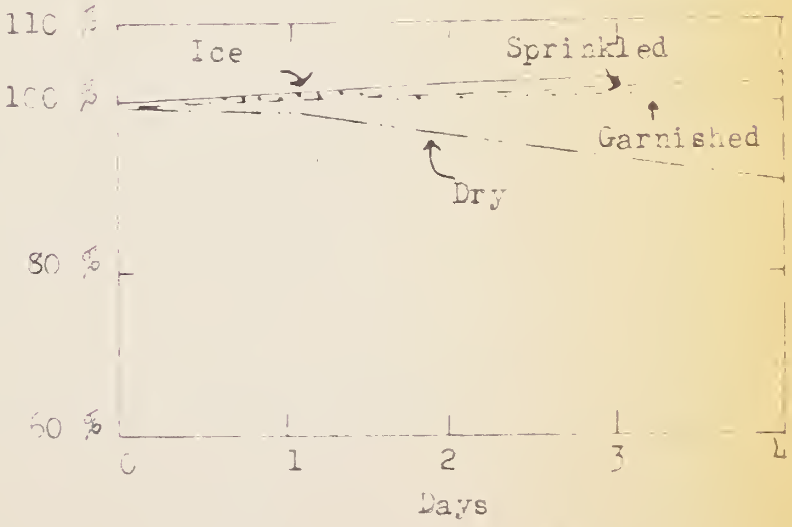

Figure 9. The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Cucumbers

Cucumbers grown on the Eastern Shore of Maryland and in New Jersey were used in the tests. The cucumbers varied somewhat as to maturity and a few had shrivelled ends, but they were in fairly good condition. Figures 10, 11, and 12 show the results during the 4 days on the 4 types of display racks.

Ice Bed Rack. -- The cucumbers on the ice bed rack absorbed moisture resulting in a 0 5 percent increase in weight. The fairly good condition was maintained with no losses during the 4 day display period.

Garnished Rack. -- The cucumbers garnished with ice gained 2 percent in weight. They remained in fairly good condition 2 days and were in fair condition the fourth day. Spoilage due to development of Anthracnose spots and other types of decay caused almost 7 percent loss by the third and fourth days. This loss was partly offset by the gain in weight.

Sprinkled Rack. -- Cucumbers on the sprinkled rack were still in a fairly good condition after 1 day and in fair to poor condition by the fourth day. They not only failed to increase in weight but lost 2 percent of their original weight. Spoilage due to end shriveling, Pythium decay, and Anthracnose amounted to 8 percent, giving a total loss of 10 percent.

Dry Rack. -- Cucumbers displayed on the dry rack remained in fairly good condition only 1 day and by the fourth day were in poor condition. Spoilage on the dry rack was more rapid than on the other 3 types of racks. The spoilage loss of 21 percent was caused mostly by end shriveling, Pythium decay, and Anthracnose. A weight loss of 5 percent gave a total loss of 26 percent during the 4 day period.

All Racks. -- Pitting occurred on all the display racks by the fourth day Most of the spoilage occurred on the smaller, more immature fruit.

Comparison of cucumbers on 4 types * of display racks during a 4 day period

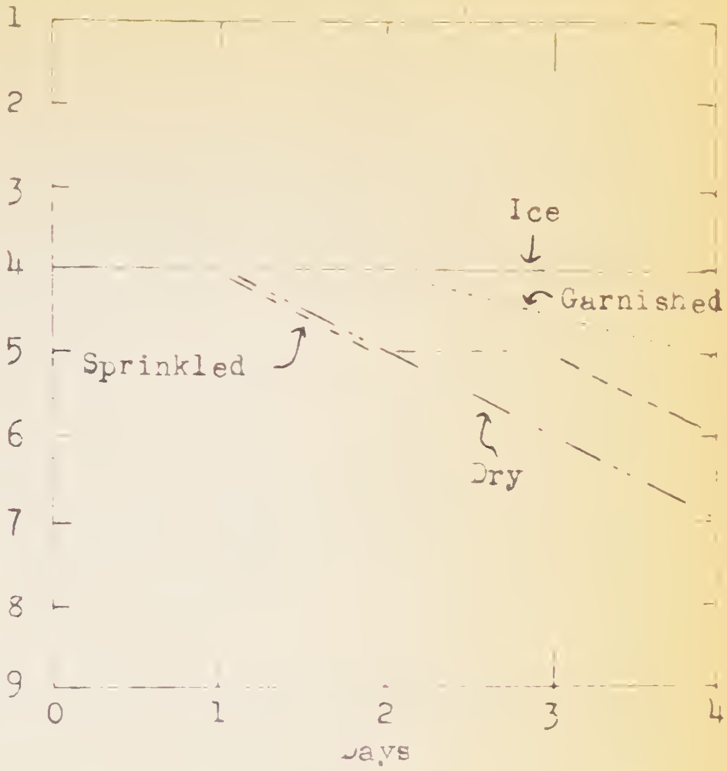

Figure 11 The daily condition of the cucumbers.

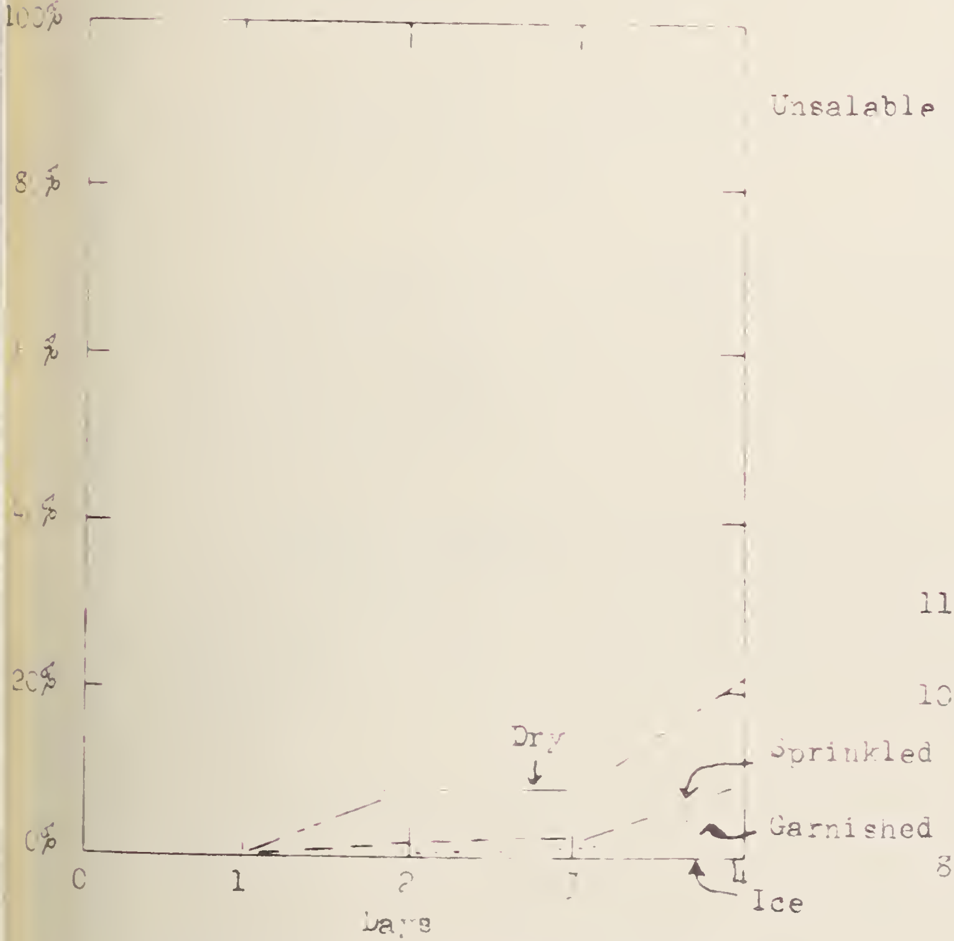

Figure 10. The daily percentage of accumulated spoilage.

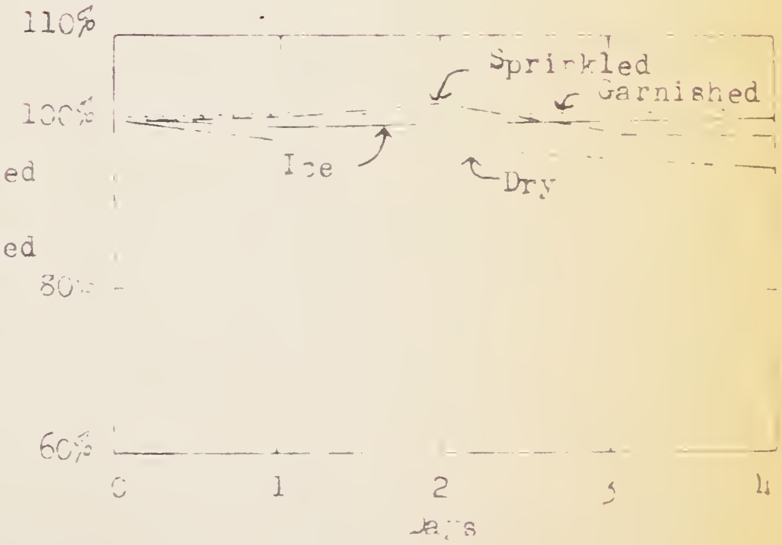

Figure 12. The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture

* Iced Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Eggplant

Eggplant grown on the Eastern Shore of Maryland were used in the tests. They were fresh, of good quality, and no spoilage occurred under any of the display treatments No cold injury was evident after 4 days refrigeration with ice or night storage at 40°F. Weight changes were very slight on all 4 of the display racks.

Green Onions

Green onions grown in New York were used in the tests. They were in good condition and free from bruising and decay. Figures 13, 14 and 15 show the results during the 4 days on 4 types of retail display racks.

Ice Bed Rack. -- The green onions displayed on the ice bed remained in good condition 4 days without any spoilage and weighed the same as at the start of the tests.

Garnished Rack. — Green onions garnished with snow ice remained in good condition 3 days and were in fair condition the fourth day. Although there was some slight bacterial decay, none were discarded because of spoilage. They weighed the same after 4 days as at the start of the tests.

Sprinkled Rack. — Green onions on the sprinkled rack remained in good condition only 2 days and were in poor condition the fourth day due to bacterial decay and discoloration of the roots. There was no spoilage, but the loss in weight due to the loss of moisture resulted in a 10 percent loss during the 4 day period

Dry Rack. -- The onions displayed on the dry rack were only in fair condition at the end of 1 day They were in a poor to unsalable condition the second day and an unsalable condition the third day. Spoilage due to bacterial decay and severe aging of the tops was 76 percent the third day, and the loss in weight was 24 percent totaling 100 percent.

All Racks. — Spoilage was much greater on the dry rack than on any of the other display racks.

Comparison of onions on 4 types * of display racks during a 4 day period.

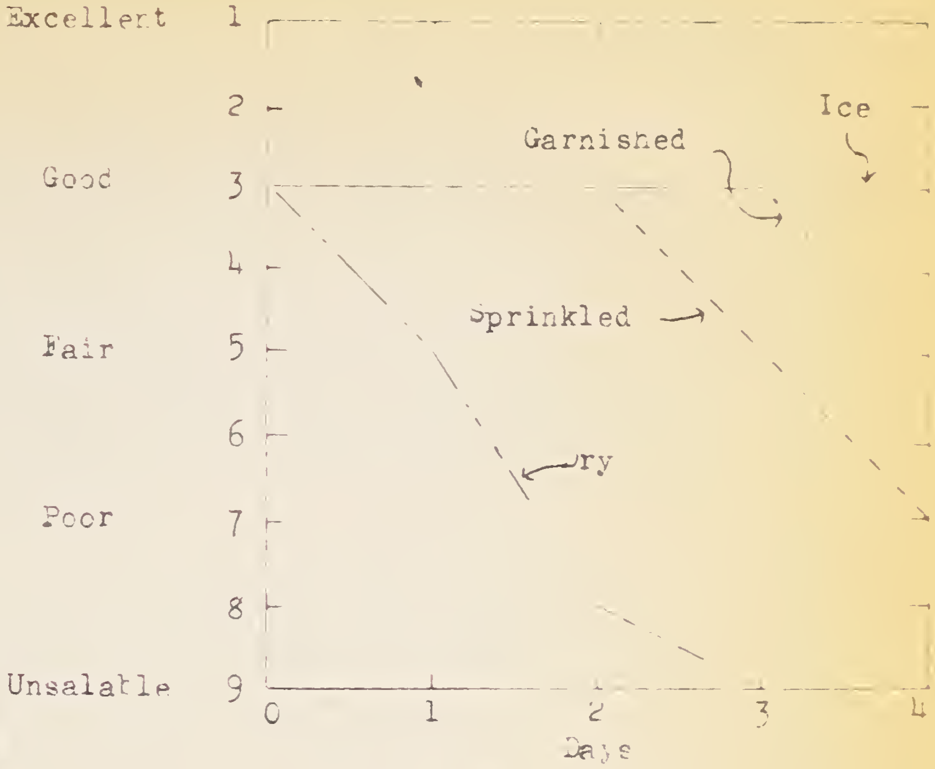

Figure 14. The daily condition of the onions.

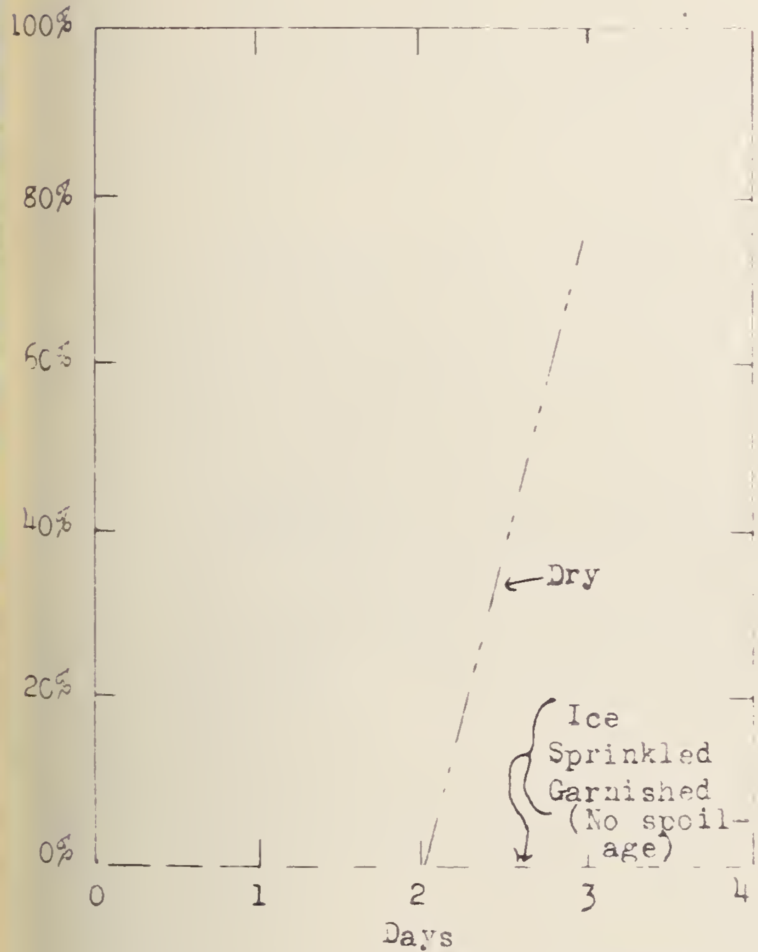

Figure 13. The daily percentage of accumulated spoilage.

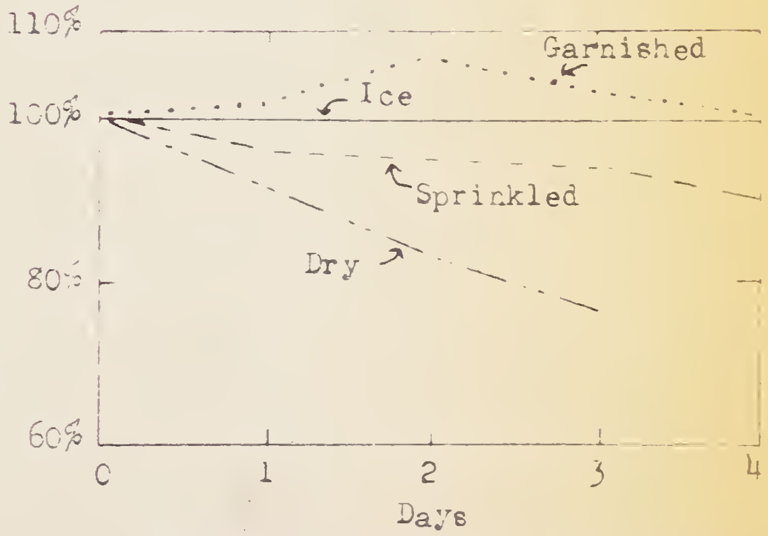

Figure 15. The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Peas

Peas grown in New York and Colorado were used in the tests. They had lost some moisture but generally were in good condition. Figures 16, 17, and 18 show the results during 4 days on the 4 types of display racks.

Ice Bed Rack. — Peas displayed on the ice bed rack remained in good condition 2 days and were in fair condition the fourth day. Spoilage due to aging was 10 percent. They gained 9 percent in weight which almost completely offset the spoilage loss.

Garnished Rack. — The peas garnished with ice were in good condition 2 days and in fair condition the fourth day. Spoilage due to aging and slight bacterial decay amounted to 9 percent. This spoilage loss was offset slightly by the 3 percent gain in weight.

Sprinkled Rack. — Peas on the sprinkled rack remained in good condition only 1 day and were in fair to poor condition on the fourth day. Spoilage due to aging and bacterial decay amounted to 13 percent during the 4 day period. The peas gained 3 percent in weight giving a total loss of 10 percent

Dry Rack. — Peas displayed on the dry rack remained in good condition 1 day. They were poor to unsalable the fourth day and had lost 23 percent in weight. Spoilage due to bacterial decay the second day and to severe withering and aging the third and fourth days was 59 percent. The spoilage loss plus the loss in weight amounted to 82 percent.

All Racks. — The ice bed and garnished racks kept the peas in a fresher, crisper condition with less decay than the other treatments.

Comparison of peas on 4 types * of display racks during a 4 day period.

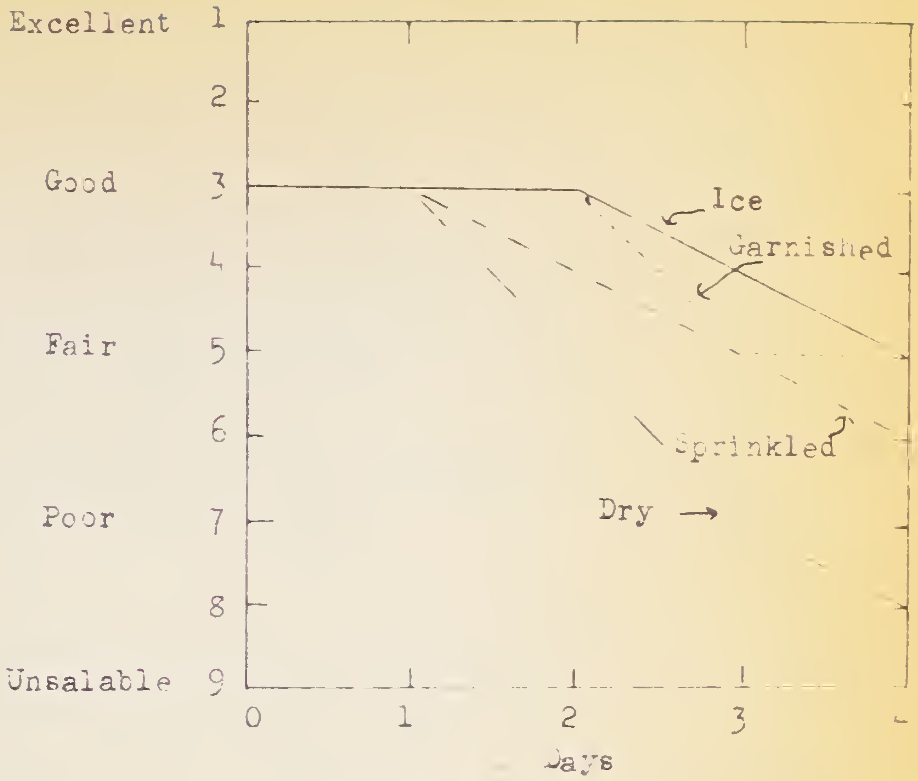

Figure 17. The daily condition of the peas.

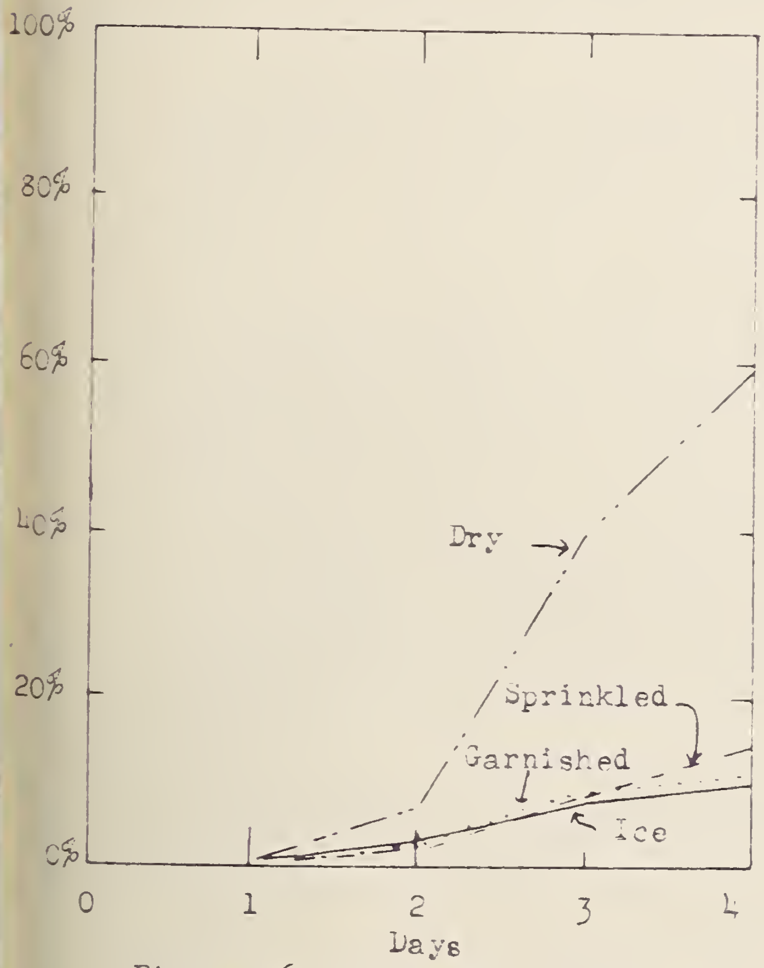

Figure 16. The daily percentage of accumulated spoilage.

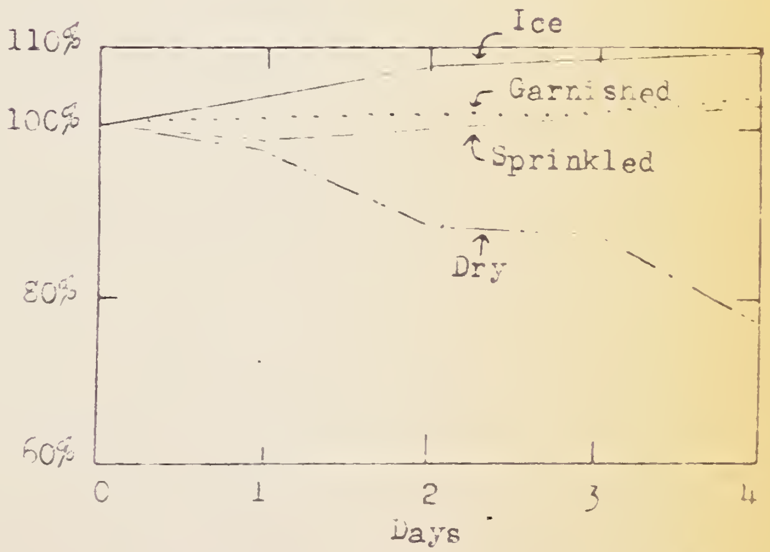

Figure 18. The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Peppers

Peppers grown in North Carolina were used in these tests. They were about 10 days old, and although some were slightly soft and yellow they were in fairly good condition. Figures 19, 20, and 21 show the results during 4 days on the 4 types of display racks.

Ice Bed Rack. — The peppers on the ice bed rack remained in fairly good condition without any spoilage during the four days. They improved in crispness and gained 6.5 percent in weight.

Garnished Rack. — Peppers garnished with ice remained in fairly good condition 3 days and were in fair condition the fourth day. Spoilage due to aging amounted to 3 percent. This loss was compensated by a 3 percent gain in weight.

Sprinkled Rack. — The peppers on the sprinkled rack remained in fairly good condition 3 days and were in fair condition the fourth day. Spoilage due to aging and slight *Botrytis* decay amounted to 6 percent which with the 3 percent loss in weight amounted to a 9 percent total loss.

Dry Rack. — Peppers displayed on the dry rack remained in fairly good condition 1 day and were in fair condition the fourth day. Spoilage due to aging amounted to 4 percent. The loss in weight was 5 percent giving a total loss of 9 percent.

All Racks. — The ice bed rack and the garnished rack kept the peppers crisper than did the other treatments.

Comparison of peppers on 4 types * of display racks during a 4 day period.

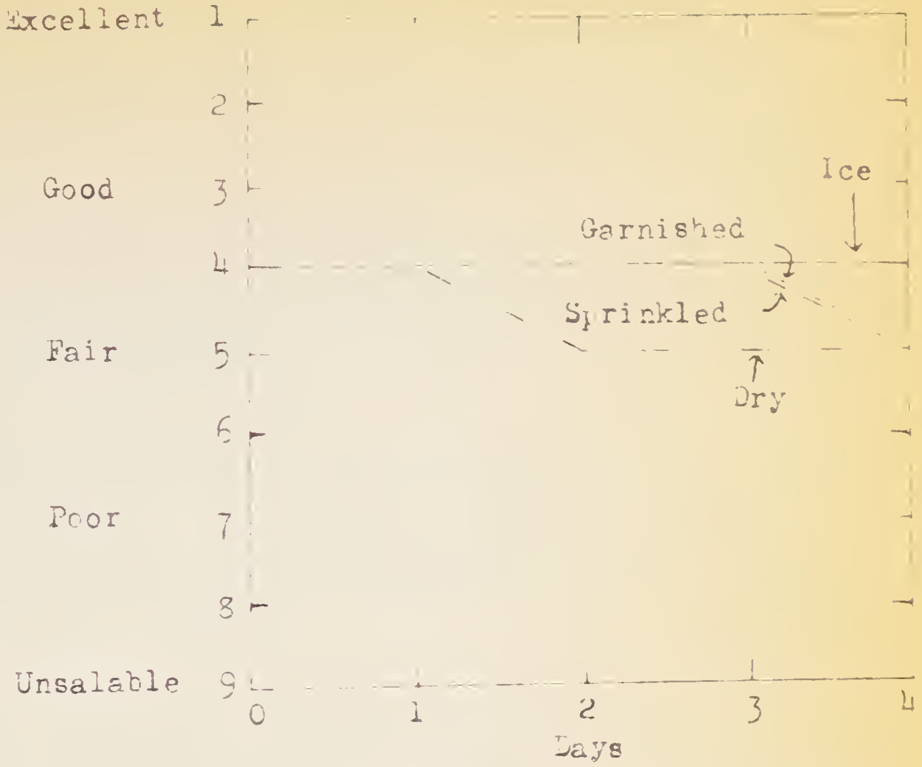

Figure 20. The daily condition of the peppers.

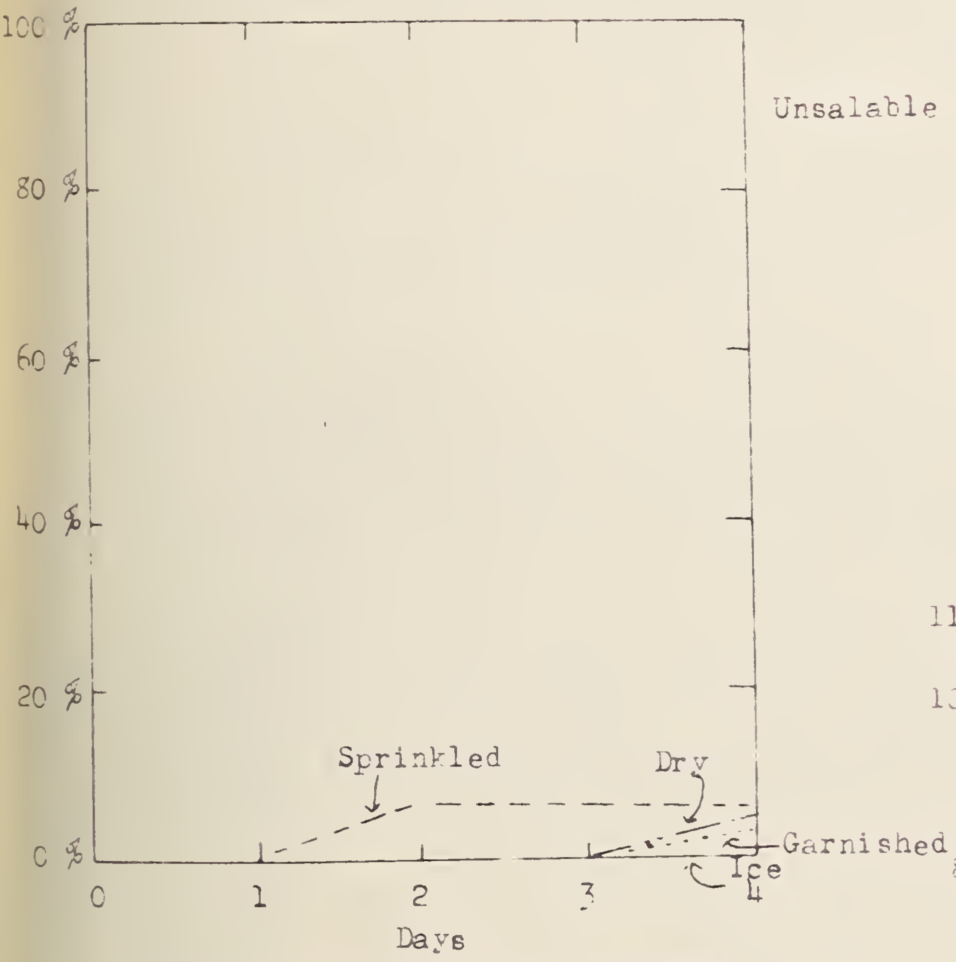

Figure 19. The daily percentage of accumulated spoilage.

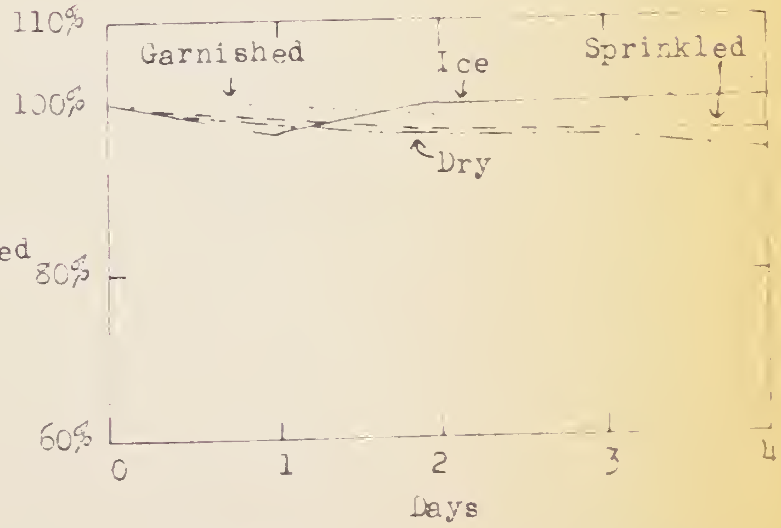

Figure 21 The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Radishes

Radishes grown in New York were used in the tests. The tops were bruised, slightly discolored, and only in fair condition while the roots were in good turgid condition. Figures 22, 23, and 24 show the results during 4 days on the 4 types of display racks.

Ice Bed Rack. — The radish tops remained in fair condition only 2 days and were in an unsalable condition the fourth day. The roots were in good condition through the fourth day. Loss in weight amounted to 5 percent. Spoilage due to bacterial decay was 95 percent the third and fourth days giving a total loss of 100 percent.

Garnished Rack. — The radish tops garnished with ice stayed in fair condition only 1 day and were unsalable the fourth day although the roots were still in good condition. Spoilage due to bacterial decay of the tops was 95 percent and the loss in weight was 5 percent giving a total loss of 100 percent in 4 days.

Sprinkled Rack. — The radish tops on the sprinkled rack remained in fair condition only 1 day and were unsalable the fourth day although the roots were in good condition. Bacterial decay spoiled 90 percent of the tops and the 10 percent loss in weight made the entire display a total loss.

Dry Rack. — The tops of radishes displayed on the dry rack were in fair to poor condition after 1 day. All were unsalable the third day but the roots were still in good condition. Spoilage due to bacterial decay of the tops amounted to 84 percent, while weight loss amounted to 16 percent giving a total loss of 100 percent in 3 days.

RADISHES

Comparison of radishes on 4 types * of display racks during a 4 day period.

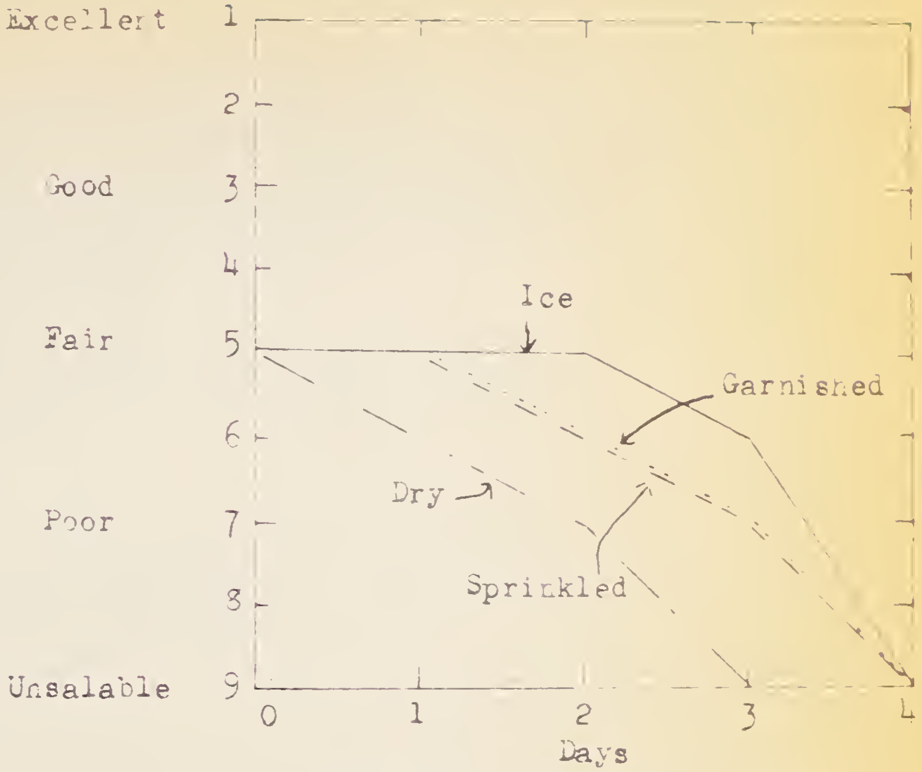

Figure 23. The daily condition of the radishes.

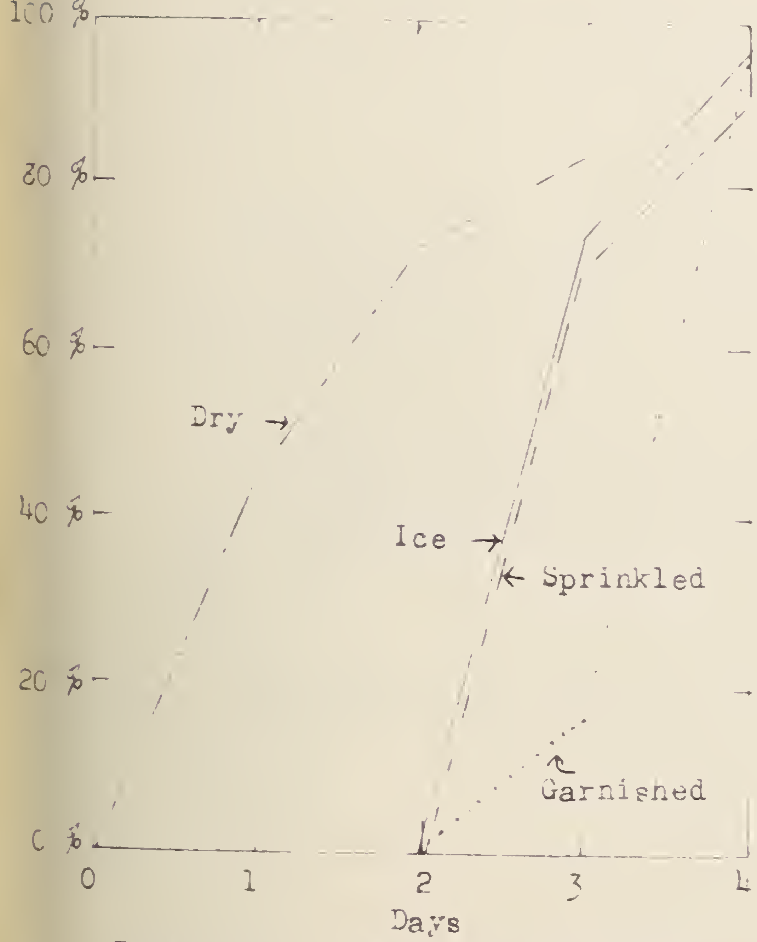

Figure 22. The daily percentage of accumulated spoilage.

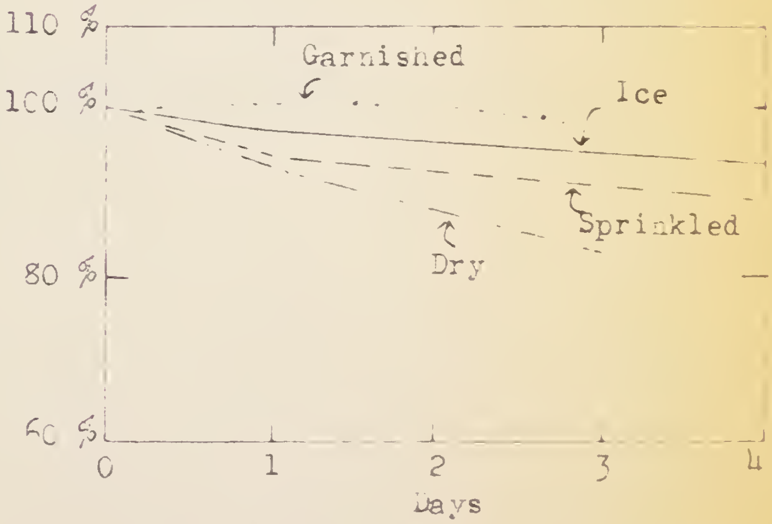

Figure 24 The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Squash

Straight neck yellow summer squash grown locally and in New Jersey were used in the tests. They were in good condition except that some were slightly soft at the blossom end. Much of the fruit was small and somewhat immature. Figures 25, 26, and 27 show the results during 4 days on 4 types of retail display racks.

Ice Bed Rack. — The squash on the ice bed rack remained in good condition 4 days. Loss in weight due to loss of moisture was 1 percent, and there was no spoilage.

Garnished Rack. — Squash garnished with ice remained in good condition 4 days. Spoilage due to *Choanephora* fruit rot amounted to 2 percent and weight gained was 2 percent, making the weight after 4 days on display the same as the original weight.

Sprinkled Rack. -- Squash displayed on the sprinkled rack remained in good condition 3 days and were in good to fair condition the fourth day. Spoilage due to *Choanephora* fruit rot was 1 percent and the loss in weight amounted to 2 percent. The total loss for the 4 day period was 3 percent.

Dry Rack. -- Squash on the dry rack remained in good condition only 1 day. *Choanephora* fruit rot caused 42 percent spoilage in 4 days. Weight loss was 9 percent bringing the total loss to 51 percent.

All Racks. -- The dry rack without any day care or night storage was the only one of the four types of racks where serious losses occurred.

Comparison of yellow summer squash on 4 types * of display racks during a 4 day period.

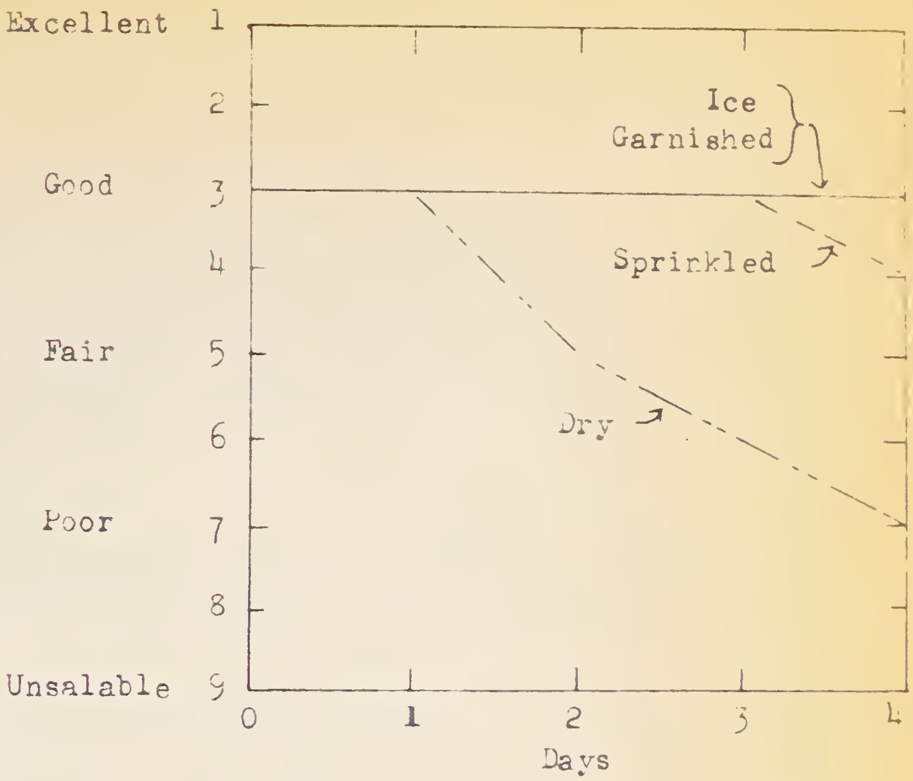

Figure 26. The daily condition of the squash.

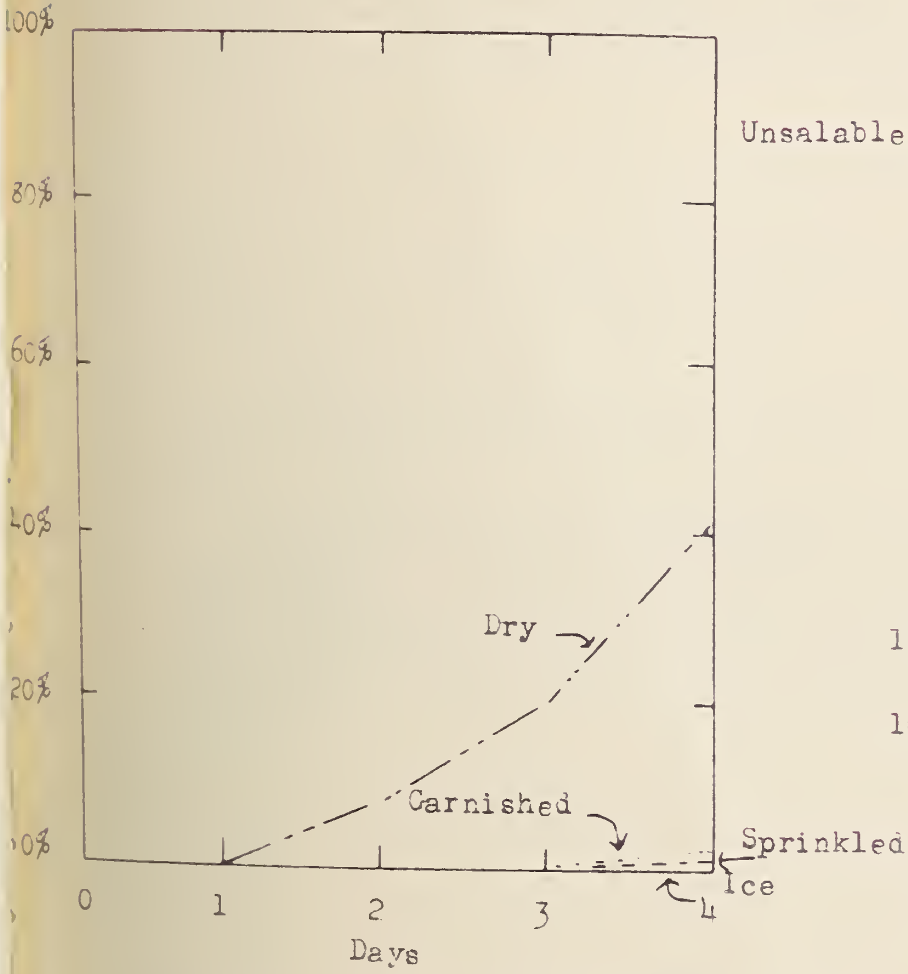

Figure 25. The daily percentage of accumulated spoilage.

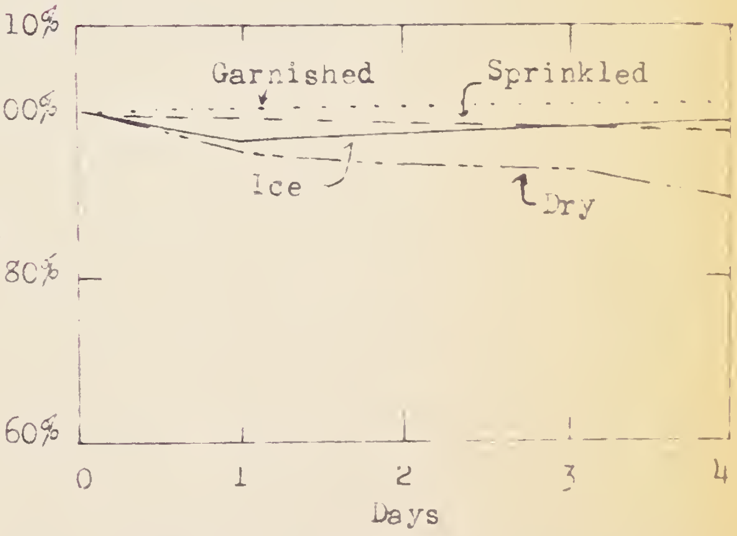

Figure 27. The daily percentage of accumulated loss or gain from the original weight due to loss or gain of moisture.

* Ice Bed Rack
Garnished Rack (ice spread over top)
Sprinkled Rack
Dry Rack

Discussion

The commodities held on the ice bed rack were generally in good condition longer than they were on the other types of display racks. This was due to the temperature and moisture provided by the ice. The low temperature held diseases to a minimum, and the moisture kept the produce in a relatively turgid condition. None of the produce appeared to be injured by being held on ice and most of it appeared greatly benefited.

The rack garnished with ice maintained lower temperatures during the day, but as the ice melted the temperature rose enough at night to allow the development of disease somewhat more than on the ice bed rack. The supply of moisture usually resulted in the commodity gaining weight.

The commodities held on the sprinkled rack during the day and at 40° F. at night were in good condition longer than those on the dry rack. The moisture was readily absorbed and most produce gained in weight. The warmer temperature during the day favored more rapid development of disease and advanced the aging in many commodities.

The commodities held on the dry rack remained in good condition only a relatively short time. The high temperature increased decay while the lack of moisture caused severe withering and aging.

Commodities such as radishes, green onions, beets, beans, and peas appeared to be benefited much more by the cool moist conditions than were eggplant, cucumbers, and squash during the 4 day holding period. Eggplant, however, was the only commodity tested that remained about the same on all four types of display racks.